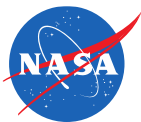




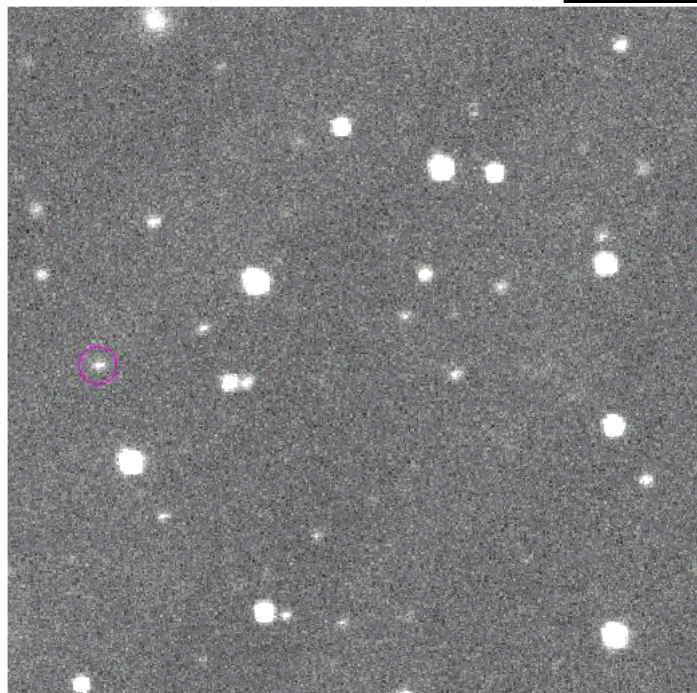
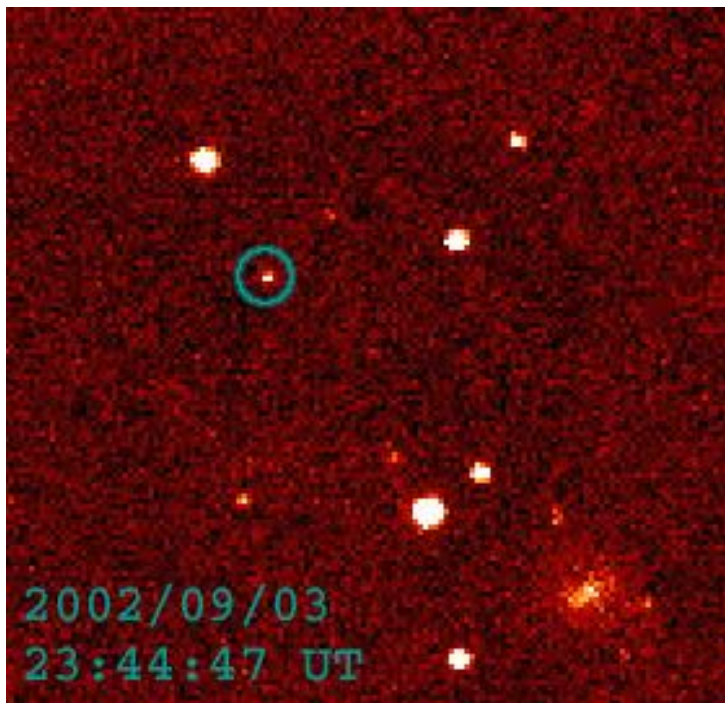
# SCOUT

## Short-Arc Orbit Analysis and Hazard Assessment for Newly Discovered Asteroids



**Jet Propulsion Laboratory**  
California Institute of Technology

D. Farnocchia, S.R. Chesley,  
A.B. Chamberlin, S.E. Khudikyan



# Time is of the essence

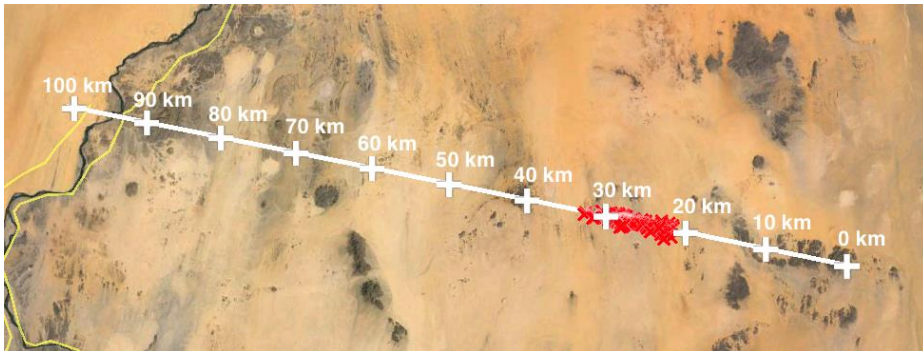


~ 5 m

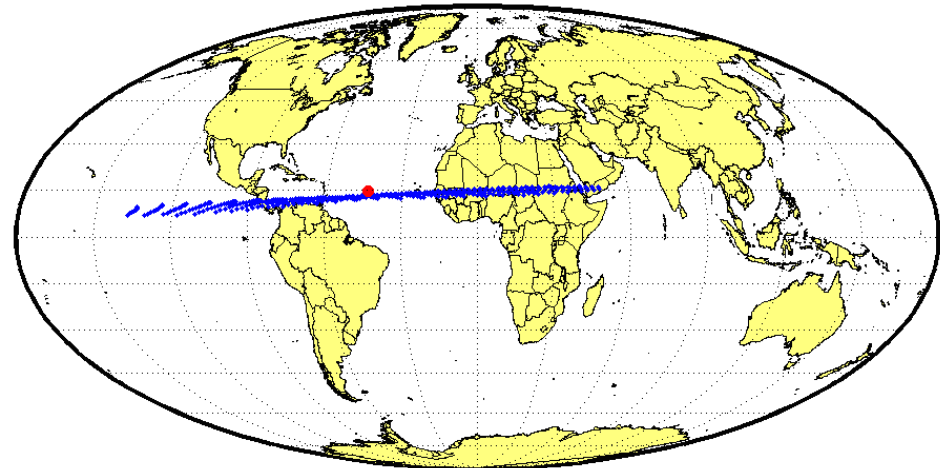
R. Kowalski, Catalina Sky Survey

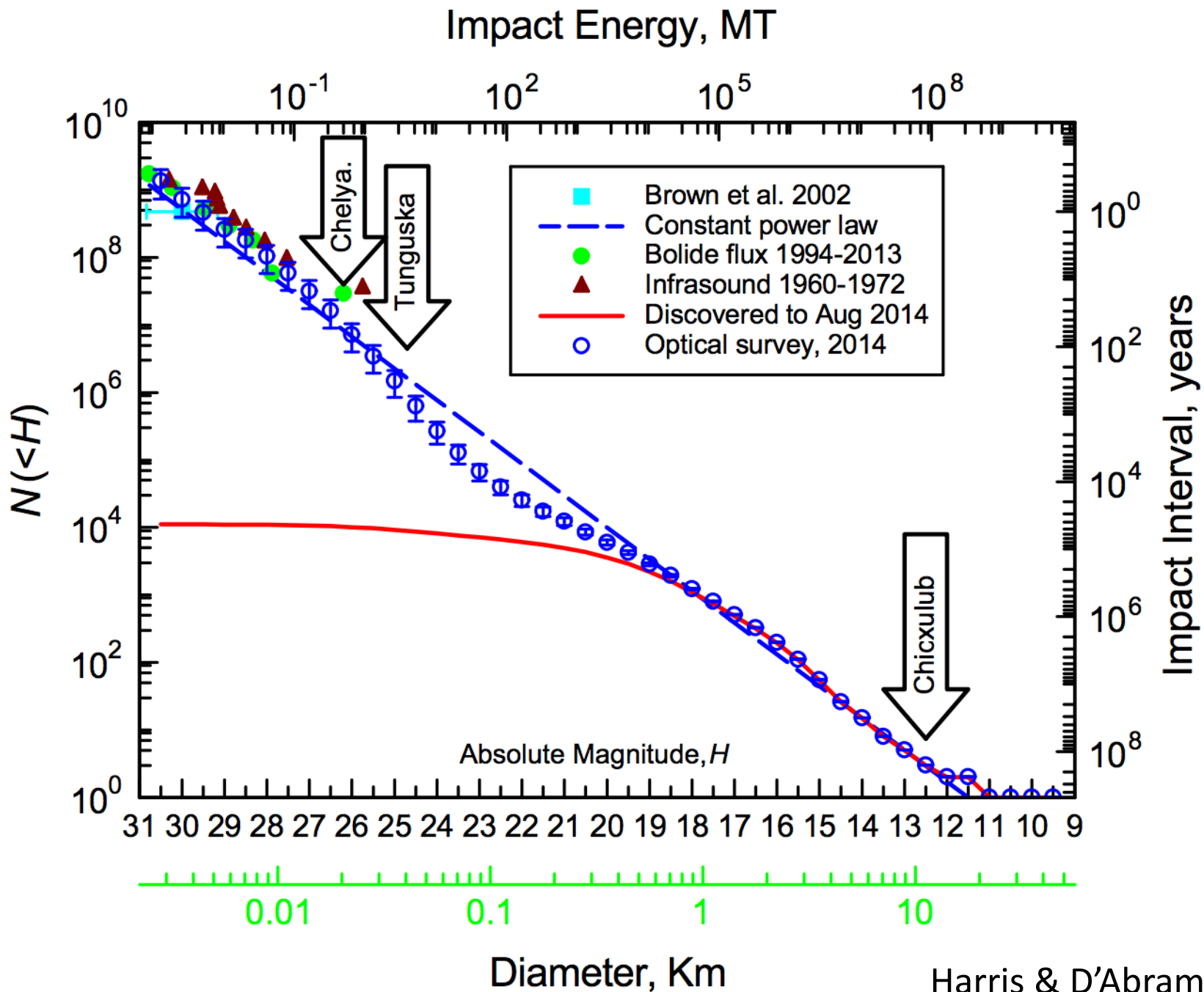
~ 20 hours before impact

2008 TC<sub>3</sub> Nubian desert, Sudan

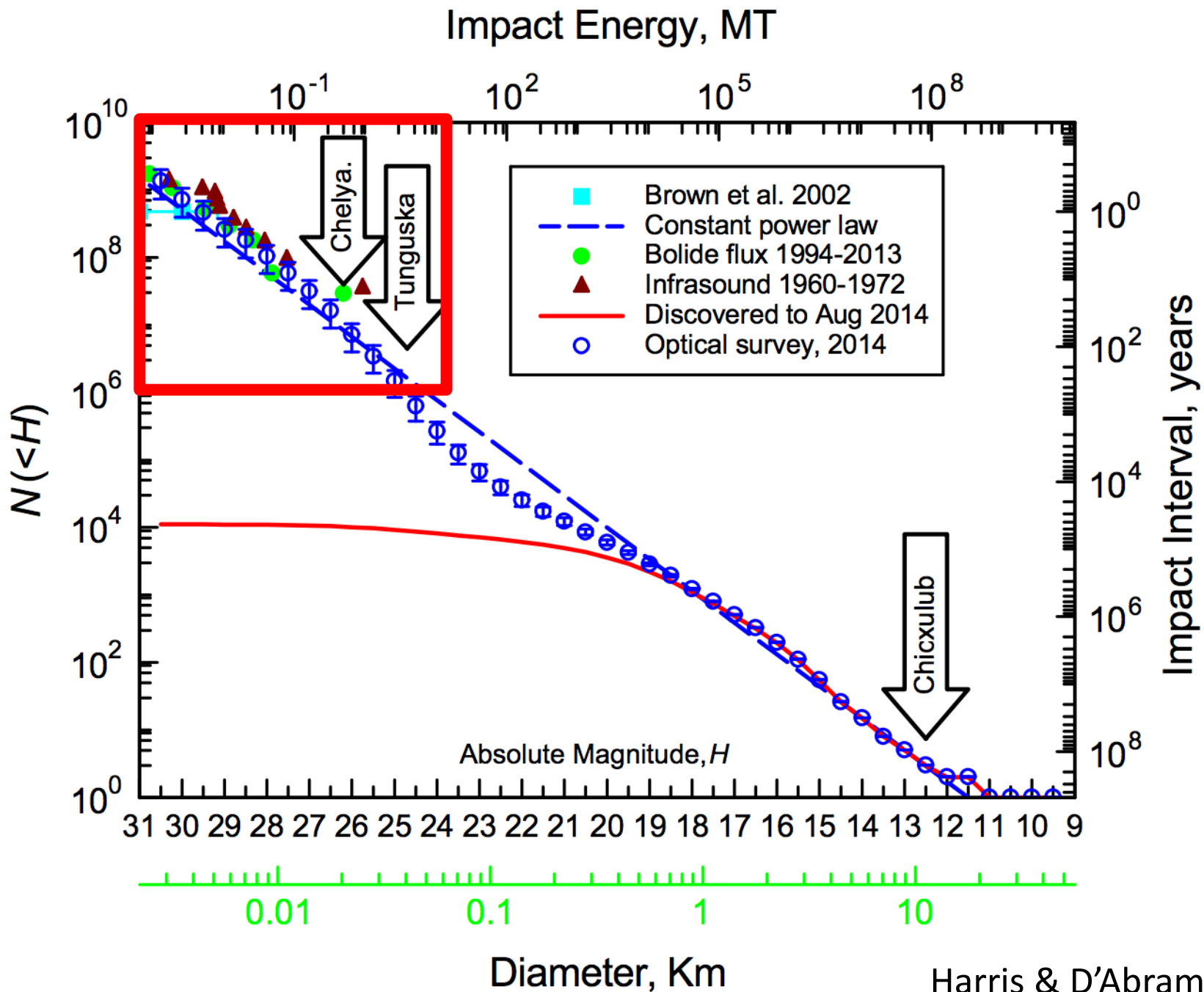


2014 AA Atlantic Ocean











- Processing ([Info](#))

## The NEO Confirmation Page

Please ensure you are familiar with the [notes at the bottom of this page](#).

Page last updated on Apr. 24.765 UTC.

[Problems?](#) [Comments?](#)

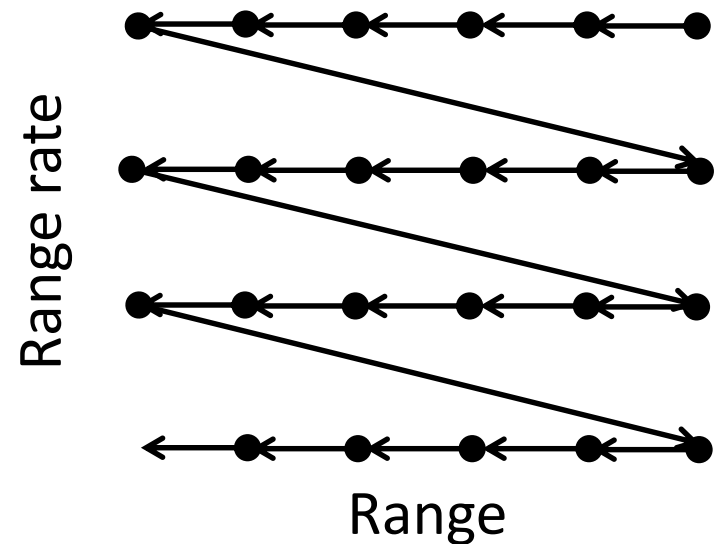
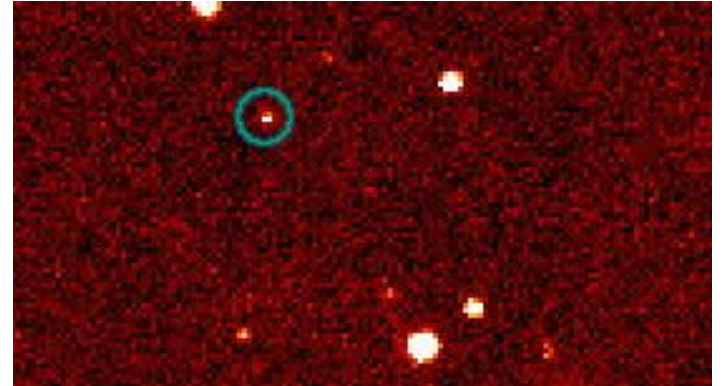
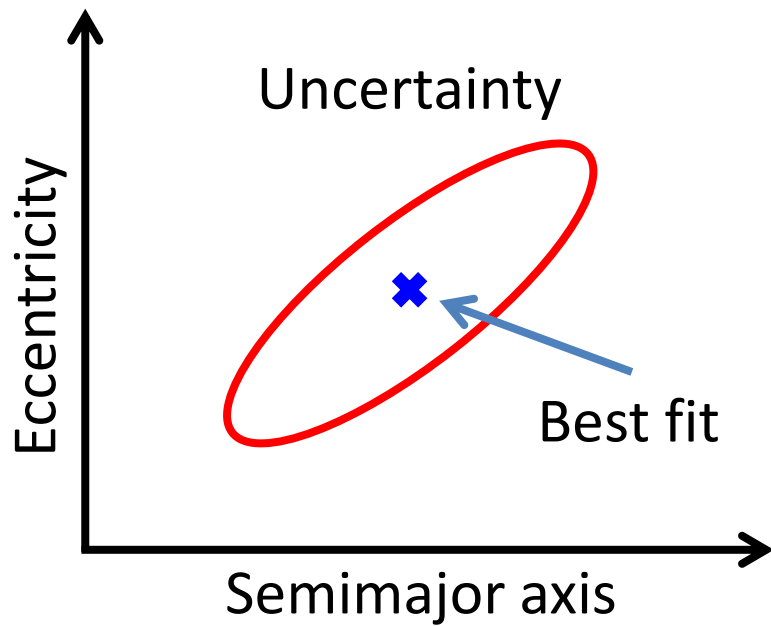
Select object(s) from the current list of objects needing confirmation (NEO desirability score, discovery date, rough current position and magnitude given, as well as number of observations, arc, nominal  $H$  and number of days since it was last observed):

☐ All objects with  $V =$   to , with Decl. between ° and °, with an NEO desirability score of % to %

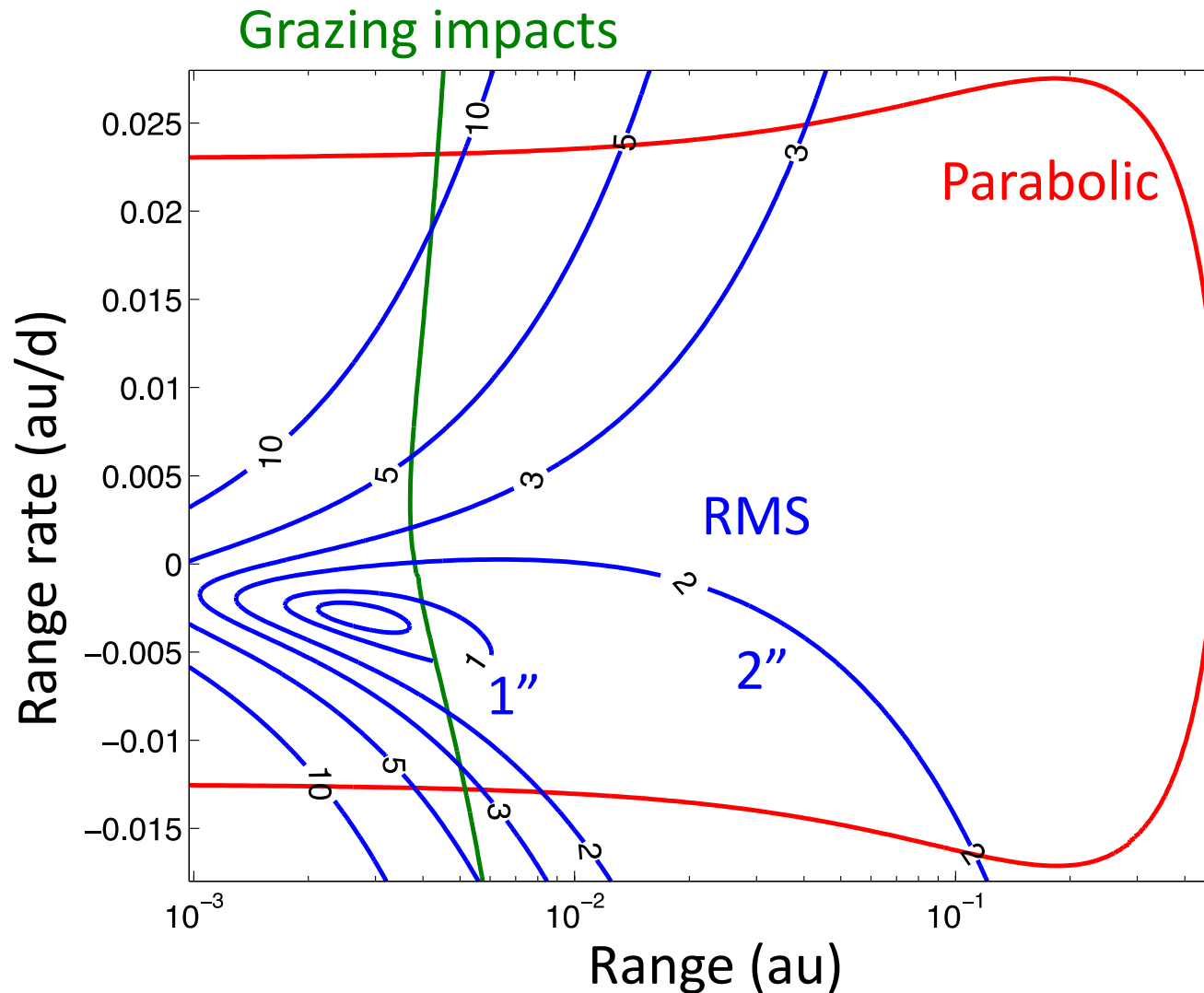
☒ or just the objects selected below:

Temp Desig	Score	Discovery	R.A.	Decl.	V	Updated	Note	NObs	Arc	H	Not Seen/dys
<input type="checkbox"/> YH81933	79	2017 04 24.3	14 19.7	-05 15	21.1	Added Apr. 24.49 UT		4	0.01	18.7	0.398
<input type="checkbox"/> YH81944	78	2017 04 24.3	15 40.4	+46 19	21.0	Added Apr. 24.49 UT		4	0.02	19.2	0.364
<input type="checkbox"/> YH818BB	82	2017 04 24.2	13 55.1	+14 07	21.0	Added Apr. 24.49 UT		3	0.02	20.2	0.467
<input type="checkbox"/> YH3DB5A	82	2017 04 24.3	16 29.2	-17 18	19.3	Updated Apr. 24.47 UT		8	0.08	18.7	0.307
<input type="checkbox"/> YH81941	100	2017 04 24.3	16 21.5	+33 30	18.4	Updated Apr. 24.46 UT		11	0.07	25.3	0.325
<input type="checkbox"/> YH818CE	100	2017 04 24.3	15 37.4	+39 30	21.2	Updated Apr. 24.45 UT		11	0.09	21.7	0.327

# Systematic ranging



# Systematic ranging on 2014 AA





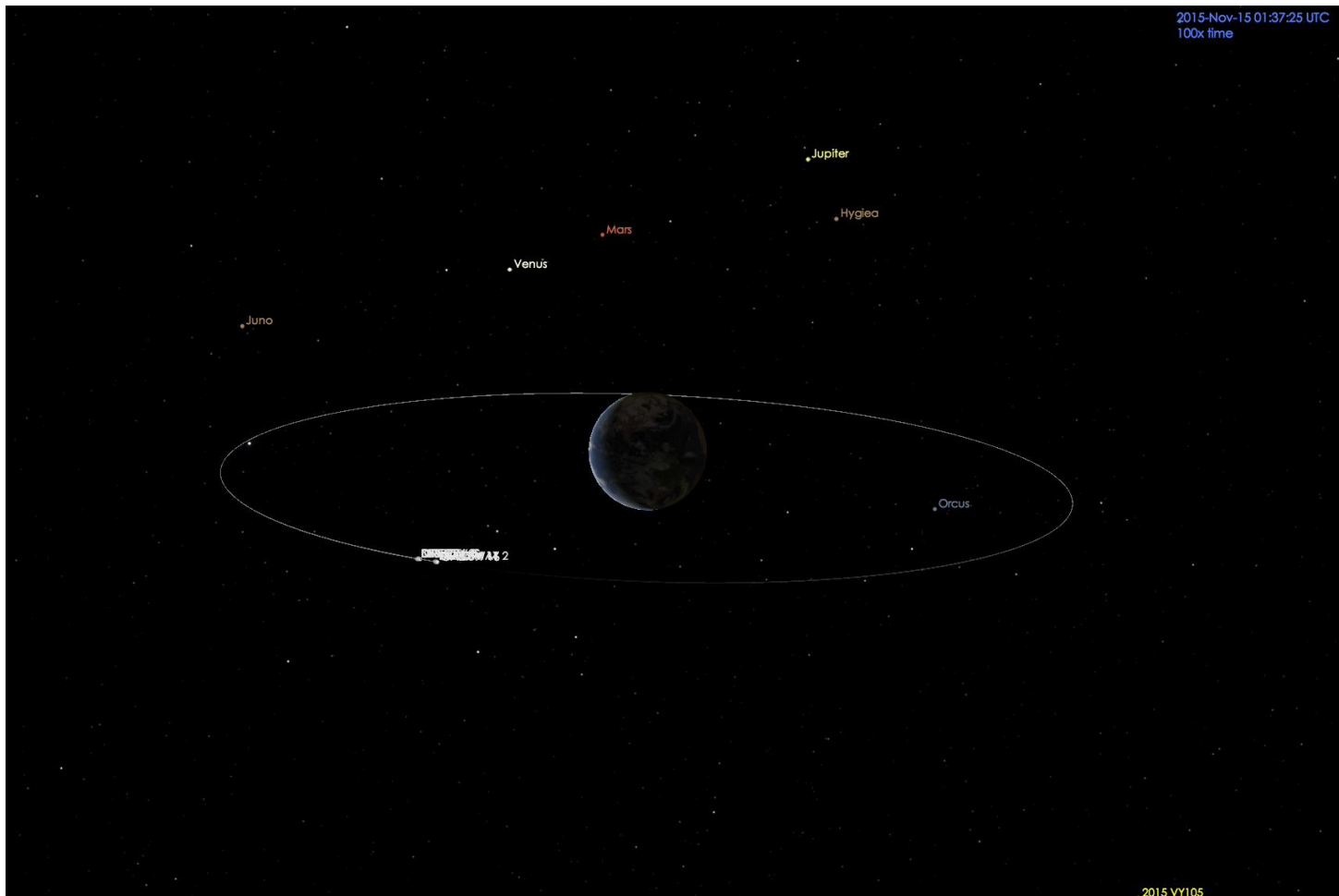
# Rapid identification of interesting objects

Object	Number of observations	Arc length	Impact probability
2008 TC <sub>3</sub>	4	43 min	4%
2008 TC <sub>3</sub>	7	99 min	100%
2014 AA	3	28 min	3%
2014 AA	7	69 min	100%

Once the data are available, Scout takes ~10 min to process an object

# 2015 VY105

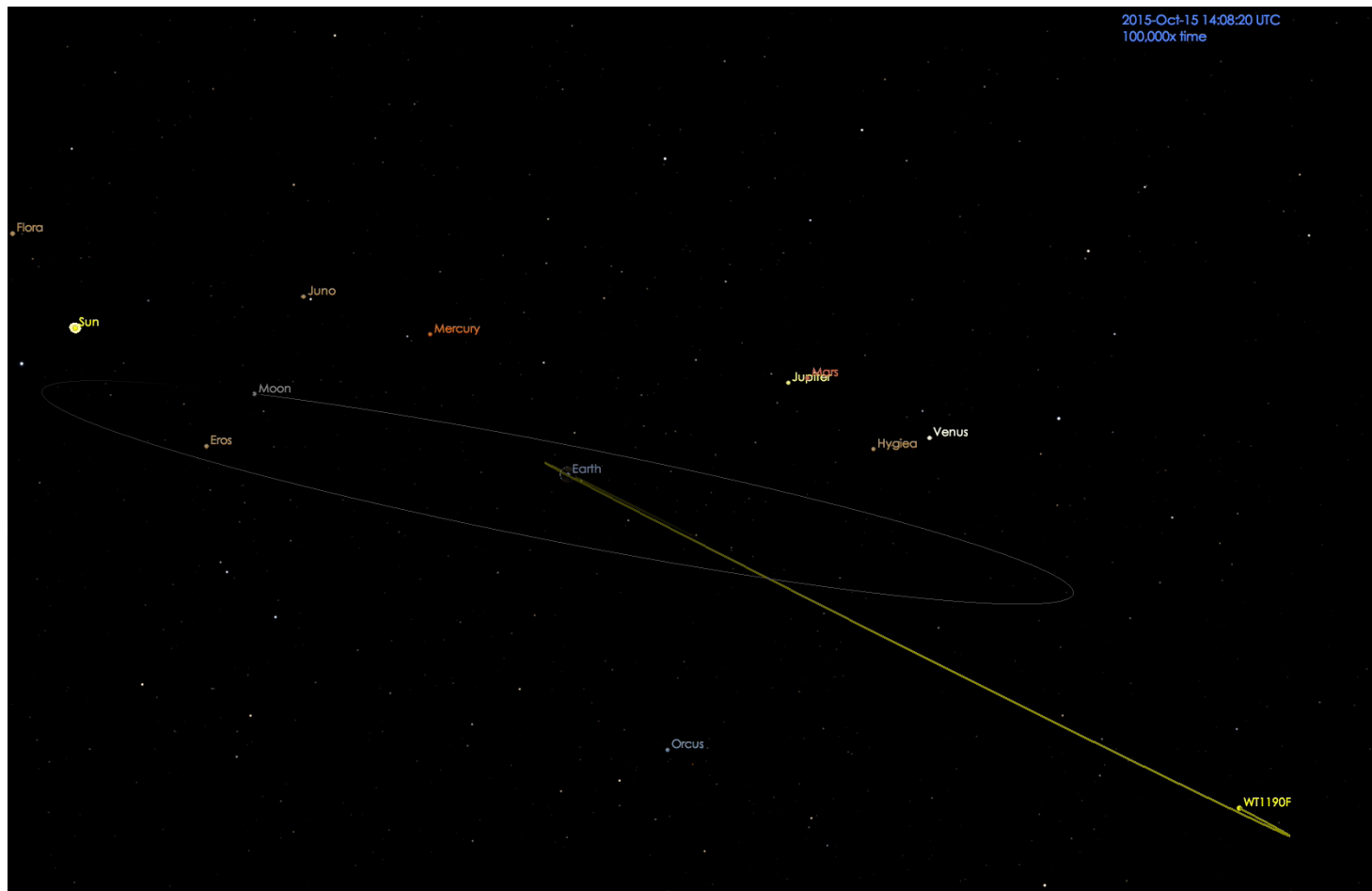
Discovered on 2015 Nov 14 07:50am UTC, Scout alert 45 min later



250 km to  
450 km of  
eight geosats

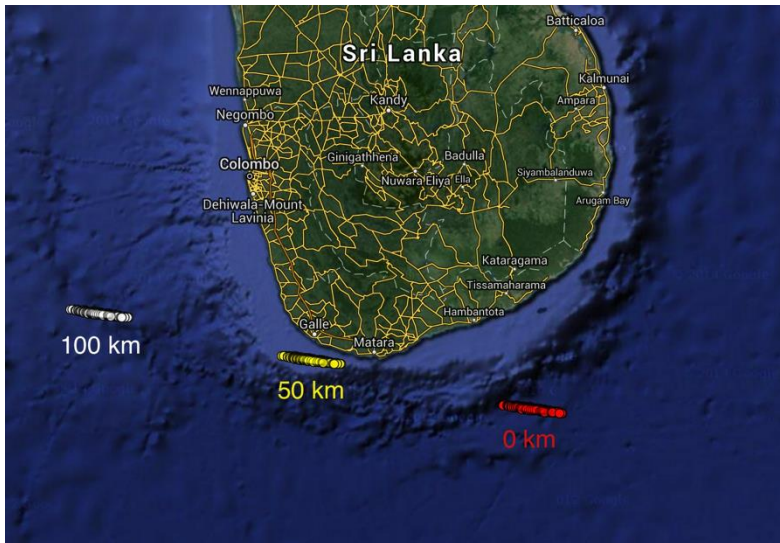
# WT1190F

Artificial object, geocentric orbit detected by Scout  
10,000 km  $\times$  600,000 km orbit



# WT1190F

Impact and airborne observation campaign (Jenniskens et al. 2016)



2015 Nov 13 06:19 UTC

Naked eye



Single frame movie camera



# Scout

## Data Table

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Show

10

entries

Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V-inf (km/s)	PHA	NEO	NEO >1km	Geo.	IEO	T <sub>J</sub> < 3	Last Upd
<a href="#">XT9742B</a>	12	24.06	0.85	29.7	0	0.001	0.56	8.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D939</a>	7	1.41	0.31	27.5	0	0.001	0.97	10.3	0	100	0	0	0	0	2016-10-1
<a href="#">XT9E194</a>	7	1.10	0.41	26.4	0	0.004	1.35	10.4	0	100	0	0	0	54	2016-10-1
<a href="#">XT9B05B</a>	26	25.01	0.42	26.2	0	0.01	3.78	3.5	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D0C1</a>	14	4.91	0.41	26.0	0	0.006	6.41	2.0	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D4BE</a>	8	1.23	0.43	25.9	0	0.006	8.22	8.7	0	100	0	0	0	50	2016-10-1
<a href="#">XT9D5EC</a>	7	1.17	0.77	25.3	0	0.02	9.48	15.6	0	100	0	0	0	48	2016-10-1
<a href="#">P10xk6Z</a>	3	0.63	0.19	21.3	0	0.01	9.60	41.4	27	73	0	0	0	46	2016-10-0
<a href="#">P10xmeh</a>	6	22.32	0.24	26.4	0	0.01	9.65	9.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9512F</a>	6	0.29	0.35	25.2		0.03	10.65	23.6	0	100	0	0	0	39	2016-10-0



# Scout

## Data Table

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Show 10 entries

Impact rating

Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V-inf (km/s)	PHA	NEO	NEO >1km	Geo.	IEO	T <sub>J</sub> < 3	Last Upd
<a href="#">XT9742B</a>	12	24.06	0.85	29.7	0	0.001	0.56	8.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D939</a>	7	1.41	0.31	27.5	0	0.001	0.97	10.3	0	100	0	0	0	0	2016-10-1
<a href="#">XT9E194</a>	7	1.10	0.41	26.4	0	0.004	1.35	10.4	0	100	0	0	0	54	2016-10-1
<a href="#">XT9B05B</a>	26	25.01	0.42	26.2	0	0.01	3.78	3.5	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D0C1</a>	14	4.91	0.41	26.0	0	0.006	6.41	2.0	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D4BE</a>	8	1.23	0.43	25.9	0	0.006	8.22	8.7	0	100	0	0	0	50	2016-10-1
<a href="#">XT9D5EC</a>	7	1.17	0.77	25.3	0	0.02	9.48	15.6	0	100	0	0	0	48	2016-10-1
<a href="#">P10xk6Z</a>	3	0.63	0.19	21.3	0	0.01	9.60	41.4	27	73	0	0	0	46	2016-10-0
<a href="#">P10xmeh</a>	6	22.32	0.24	26.4	0	0.01	9.65	9.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9512F</a>	6	0.29	0.35	25.2		0.03	10.65	23.6	0	100	0	0	0	39	2016-10-0

# Scout

## Data Table

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Show 10 entries

Close approach distance

Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V-inf (km/s)	PHA	NEO	NEO >1km	Geo.	IEO	T <sub>J</sub> < 3	Last Upd
<a href="#">XT9742B</a>	12	24.06	0.85	29.7	0	0.001	0.56	8.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D939</a>	7	1.41	0.31	27.5	0	0.001	0.97	10.3	0	100	0	0	0	0	2016-10-1
<a href="#">XT9E194</a>	7	1.10	0.41	26.4	0	0.004	1.35	10.4	0	100	0	0	0	54	2016-10-1
<a href="#">XT9B05B</a>	26	25.01	0.42	26.2	0	0.01	3.78	3.5	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D0C1</a>	14	4.91	0.41	26.0	0	0.006	6.41	2.0	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D4BE</a>	8	1.23	0.43	25.9	0	0.006	8.22	8.7	0	100	0	0	0	50	2016-10-1
<a href="#">XT9D5EC</a>	7	1.17	0.77	25.3	0	0.02	9.48	15.6	0	100	0	0	0	48	2016-10-1
<a href="#">P10xk6Z</a>	3	0.63	0.19	21.3	0	0.01	9.60	41.4	27	73	0	0	0	46	2016-10-0
<a href="#">P10xmeh</a>	6	22.32	0.24	26.4	0	0.01	9.65	9.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9512F</a>	6	0.29	0.35	25.2		0.03	10.65	23.6	0	100	0	0	0	39	2016-10-0

# Scout

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Show 10 entries

Mission accessible

Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V-inf (km/s)	PHA	NEO	NEO >1km	Geo.	IEO	T <sub>J</sub> < 3	Last Upd
<a href="#">XT9742B</a>	12	24.06	0.85	29.7	0	0.001	0.56	8.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D939</a>	7	1.41	0.31	27.5	0	0.001	0.97	10.3	0	100	0	0	0	0	2016-10-1
<a href="#">XT9E194</a>	7	1.10	0.41	26.4	0	0.004	1.35	10.4	0	100	0	0	0	54	2016-10-1
<a href="#">XT9B05B</a>	26	25.01	0.42	26.2	0	0.01	3.78	3.5	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D0C1</a>	14	4.91	0.41	26.0	0	0.006	6.41	2.0	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D4BE</a>	8	1.23	0.43	25.9	0	0.006	8.22	8.7	0	100	0	0	0	50	2016-10-1
<a href="#">XT9D5EC</a>	7	1.17	0.77	25.3	0	0.02	9.48	15.6	0	100	0	0	0	48	2016-10-1
<a href="#">P10xk6Z</a>	3	0.63	0.19	21.3	0	0.01	9.60	41.4	27	73	0	0	0	46	2016-10-0
<a href="#">P10xmeh</a>	6	22.32	0.24	26.4	0	0.01	9.65	9.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9512F</a>	6	0.29	0.35	25.2		0.03	10.65	23.6	0	100	0	0	0	39	2016-10-0

# Scout

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Show 10 entries

Scores for PHA, NEO, Geocentric, Cometary

Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V-inf (km/s)	PHA	NEO	NEO >1km	Geo.	IEO	T <sub>J</sub> < 3	Last Upd
<a href="#">XT9742B</a>	12	24.06	0.85	29.7	0	0.001	0.56	8.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D939</a>	7	1.41	0.31	27.5	0	0.001	0.97	10.3	0	100	0	0	0	0	2016-10-1
<a href="#">XT9E194</a>	7	1.10	0.41	26.4	0	0.004	1.35	10.4	0	100	0	0	0	54	2016-10-1
<a href="#">XT9B05B</a>	26	25.01	0.42	26.2	0	0.01	3.78	3.5	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D0C1</a>	14	4.91	0.41	26.0	0	0.006	6.41	2.0	0	100	0	0	0	0	2016-10-1
<a href="#">XT9D4BE</a>	8	1.23	0.43	25.9	0	0.006	8.22	8.7	0	100	0	0	0	50	2016-10-1
<a href="#">XT9D5EC</a>	7	1.17	0.77	25.3	0	0.02	9.48	15.6	0	100	0	0	0	48	2016-10-1
<a href="#">P10xk6Z</a>	3	0.63	0.19	21.3	0	0.01	9.60	41.4	27	73	0	0	0	46	2016-10-0
<a href="#">P10xmeh</a>	6	22.32	0.24	26.4	0	0.01	9.65	9.8	0	100	0	0	0	0	2016-10-1
<a href="#">XT9512F</a>	6	0.29	0.35	25.2		0.03	10.65	23.6	0	100	0	0	0	39	2016-10-0

# Plane-of-sky uncertainty looks weird!

Select NEOCP Object ▼

## Ephemerides

Enter desired ephemeris parameters.

By default, a geocentric (code=500) ephemeris is generated at the current time with no limit

Start Time (UTC):

Current time

Observatory Code:

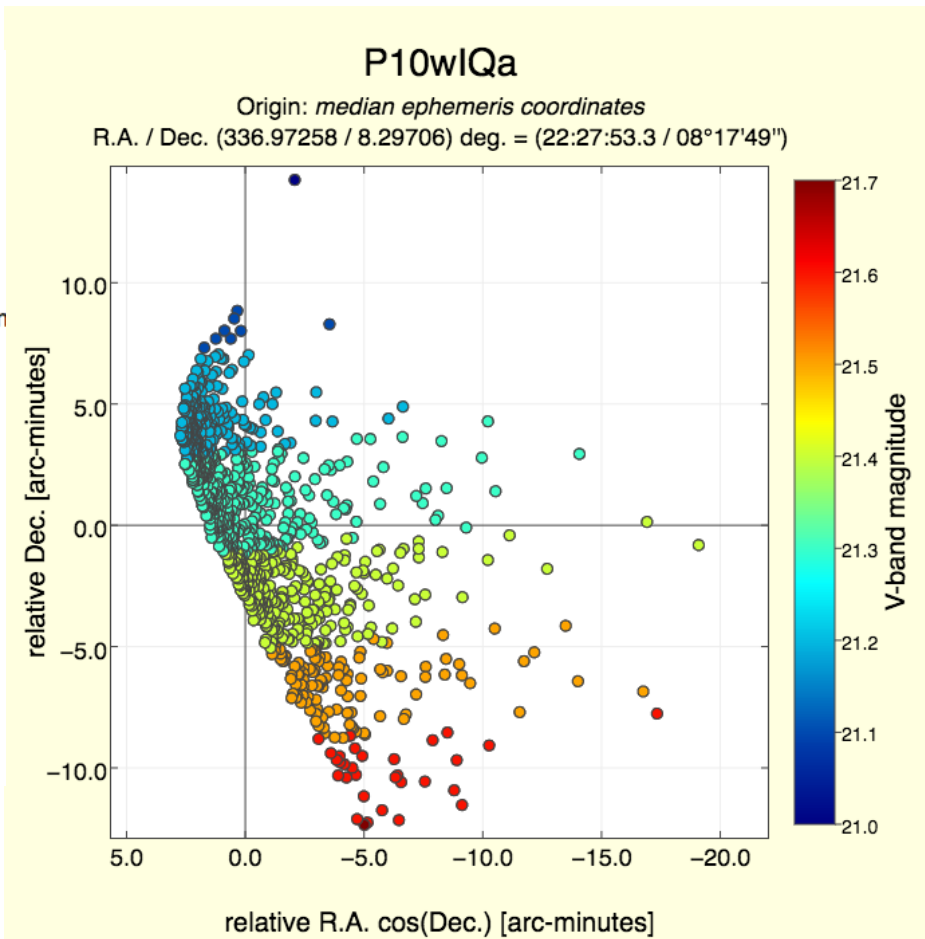
500

Stop Time (UTC):

Limiting magnitude:

Time Step:

Submit

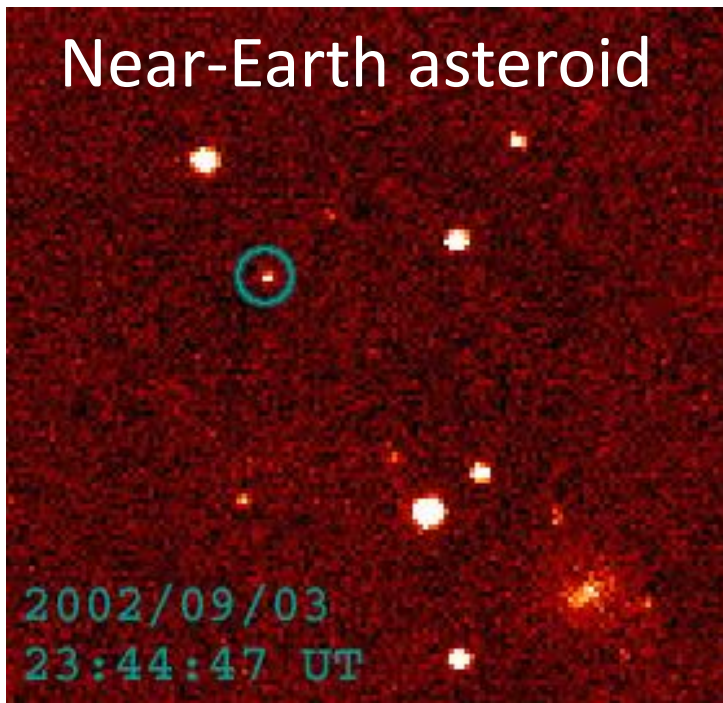




# Summary

- Scout is a JPL system for early detection of asteroid impacts: <https://cneos.jpl.nasa.gov/scout/>
- Also close approaches, mission accessible, mini-moons, ...
- Rapid and fully automated, email & text alerts
- Still unconfirmed objects from the Minor Planet Center's NEO Confirmation Page
- Ephemeris tool to help observers follow up objects

Near-Earth asteroid



Main belt asteroid



Impactor

